

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
15 January 2004 (15.01.2004)

PCT

(10) International Publication Number
WO 2004/004484 A2

(51) International Patent Classification⁷: **A23L**
(21) International Application Number: **PCT/IL2003/000551**
(22) International Filing Date: **2 July 2003 (02.07.2003)**
(25) Filing Language: **English**
(26) Publication Language: **English**
(30) Priority Data:
150534 2 July 2002 (02.07.2002) **IL**
60/395,094 5 July 2002 (05.07.2002) **US**
60/444,972 2 February 2003 (02.02.2003) **US**
60/450,531 17 February 2003 (17.02.2003) **US**

CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

(71) Applicant and
(72) Inventor: Mayer, Yaron [IL/IL]; 21 Ahad Haam Street, 92151 Jerusalem (IL).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: COMPOSITION AND METHOD FOR PREPARING CRISPY STARCHY FOODS (SUCH AS FOR EXAMPLE CHIPS, SNACKS, AND BREAKFAST CEREALS) WITHOUT DESTRUCTIVE PROCESSES THAT CREATE DANGEROUS CHEMICALS.

(57) Abstract: The consumption of highly heated starchy foods, such as for example potato chips, French fries, or breakfast cereals, has become very popular in the last 30 years, since for some reason consumers have been led into liking crispy or crunchy foods. However, recent finding published world-wide on April and June 2002 indicated that heating foods that are rich in carbohydrates to high temperatures, such as for example potato chips, French fries and various types of morning cereals, can cause the formation of large amounts of Acrylamides - up to hundreds or thousands of times more than what the World Health Organization (WHO) allows in drinking water. These substances are unnatural and there is evidence that they are dangerous carcinogens and also that they can cause damage to the human nervous system. The present invention tries to solve the above problems by preferably achieving crispiness or crunchiness and preferably also other customary properties in these foods, without heating them to high temperatures - preferably not substantially above 100 or 120 degrees Celsius.

WO 2004/004484 A2

Composition and method for preparing crispy starchy foods (such as for example chips, snacks, and breakfast cereals) without destructive processes that create dangerous chemicals.

Background of the invention

Field of the invention:

The present invention relates to healthy nutrition, and more specifically to a composition and method for preparing preferably crispy or crunchy starchy foods (such as for example chips and breakfast cereals) without dangerous processes that create dangerous chemicals, such as Acrylamides.

Background

The consumption of highly heated starchy foods, such as for example potato chips, French fries, or breakfast cereals, has become very popular in the last 30 years, since for some reason consumers have been led into liking crispy or crunchy foods. It has already been known for quite a few years that the heating of various oils beyond 120 or 150 degrees Celsius can create dangerous carcinogens. It has also been known for at least a few years that heating meats to temperatures beyond 100 or 200 degrees Celsius can cause the formation of other dangerous unnatural carcinogens such as Heterocyclic Amines (HCAs). However, recent finding published world-wide in April and June 2002 indicated that apart from oils and meats, heating foods that are rich in carbohydrates to high temperatures, such as for example chips, French fries and various types of morning cereals, can cause the formation of large amounts of Acrylamides – up to hundreds or thousands of times more than what the World Health Organization (WHO) allows in drinking water. These substances are unnatural and there is evidence that they are dangerous carcinogens and also that they can cause damage to the human nervous system. These findings were first reported at the end of April 2002 by the Stockholm University in cooperation with the Swedish government food safety agency. These results were confirmed a month later by the UK Foods Standards Agency, and a United States Consumer group and a survey conducted for the US-based Center for Science also performed tests with similar findings. At the end of June there was a 3-day UN-sponsored conference on the subject in Switzerland. Since cancer is already the number 1 killer in the Western world, affecting every 1 in 2 or 3 persons, such findings are definitely intolerable. The findings are especially shocking since for example breakfast cereals have been pushed until now as “health foods”.

According to http://www.jifsan.umd.edu/Acrylamide/WG4/WG4_Toxicology_BG.pdf, Acrylamide is an odorless, white crystalline solid at room temperature, with a molecular formula of C_3H_5NO and weight of 71.08, and is readily soluble in water (2155 g/l at 30°C). It has a boiling point of 125-136°C, and a melting point of 84-85°C. Current research shows that the main suspect source of the Acrylamides is Asparagine, which is a major free amino acid in Potatoes and some cereals. Asparagine is disintegrated by heat into Acrylamides, which are unstable short molecules that tend to react with other molecules in the human body. Acrylamides contain an α,β -unsaturated amide system that reacts with nucleophilic compounds via a Michael addition. The major site of reaction is cysteine with sulfhydryl groups contained on proteins and amino acids, although Acrylamide may also react with amino groups. However, there are probably additional ingredients that can cause Acrylamide formation even without Asparagine.

Clearly better alternatives are needed for preparing such foods that can preferably achieve the desired crispiness or crunchiness without any processes that create unnatural dangerous changes in the foods.

Summary of the invention

The present invention tries to solve the above problems by providing a much healthier alternative with less problems. This solution is based on preferably achieving crispiness or crunchiness and preferably also other customary properties in these foods, without heating them to high temperatures – preferably not substantially above 100 or 120 degrees Celsius, or other degrees where no substantial amounts of Acrylamides are formed.

There are at least a few possible solutions to the above problems, and of course various combinations or sub-combinations of them can also be used:

1. For preparing for example chips or French fries or baked morning cereals preferably the potatoes or corn are baked preferably in an oven at low heat - preferably up to 100 or 120 degrees Celsius or not substantially above this, and preferably in a vacuum or reduced air pressure and/or in an atmosphere preferably without oxygen (Of course this has the advantage that it can also prevent or decrease oxidation), in order to allow them to dehydrate more quickly without the need to reach higher temperatures. In case of potato chips or French fries or similar foods that are commonly prepared with oils,

preferably no oil is heated with the product during this heating process, and the oil is preferably only added later – after the product has already cooled down, and preferably the product is packaged in oxygen-free and light-opaque packages. In case of various breakfast cereals, such as for example those based on corn flour, preferably any other ingredients or at least any ingredients that there is no reason to heat and/or that can be degraded by heating such as for example honey or sugar are similarly only added after the product has cooled down. Preferably the baking is also done in a light-free or reduced light environment – in order to further avoid any processes that might cause various ingredients in the food to degenerate. Of course, various combinations of the above and other variations are also possible.

2. Another possible variation is to achieve the crispiness for example by covering the potatoes or breakfast cereals with a solid edible ingredient that does not need high temperature heating to become solid. Of course, various combinations of the above and other variations are also possible.
3. Another possible variation is to add various natural antioxidants to the ingredients before and/or during the baking in order to further protect them, such as for example various fruits or vitamins. Of course, various combinations of the above and other variations are also possible.
4. Another possible variation is to mix or spray the resulting baked products, preferably after cooling down, for example with meshed parts and/or juices of similar ingredients that have not been baked, so that for example if potato chips or French fries have been baked, they are preferably also covered for example by juice from meshed unbaked potatoes and/or for example injected or otherwise mixed with it, so that some of the enzymes and other natural ingredients that have been ruined or degraded by the heating are added back into the food. Of course, various combinations of the above and other variations are also possible.

The above methods are very different from the state-of-the-art for preparing such foods.

Brief description of the drawings

Fig. 1 is a graph showing the amount of Acrylamide formation as a function of temperature.

Figs. 2a-b show illustrations of two preferable variations of using ball-shaped or cylinder-shaped internal walls in a microwave oven.

Important Clarification and Glossary:

All the illustrations are just examples and should not be interpreted as limiting. Throughout the patent whenever variations or various solutions are mentioned, it is also possible to use combinations of these variations or of elements in them, and when combinations are used, it is also possible to use at least some elements in them separately. These variations are preferably in different embodiments. In other words: certain features of the invention, which are described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination.

Detailed description of the preferred embodiments

All of the descriptions in this and other sections are intended to be illustrative examples and not limiting.

Since this patent deals with a method of preparing food and the composition of such food, as is customary in this area, instead of drawings, examples of the method and of the possible compositions will be given for illustration.

In more detail, the invention preferably contains at least one but preferably more of the following main elements:

1. For preparing for example potato chips or French fries or baked morning cereals preferably the potatoes or corn are baked preferably in an oven (or any other baking device wherein the food is not cooked by immersing in water) at low heat - preferably up to 100 or 120 degrees Celsius or not substantially above this, and preferably in a vacuum or reduced air pressure and/or in an atmosphere preferably without oxygen (such as for example in a vacuum or partial vacuum containing only Nitrogen) and/or constant air suction or constant flow of air which is preferably dry and oxygen-free or oxygen reduced, in order to allow them to dehydrate more quickly without the need to reach high temperatures. In case of chips or French fries or similar foods that are commonly prepared with oils, preferably no oil is

heated with the product during this heating process, and the oil (such as for example preferably unheated and un-refined hempseed oil, flax oil, olive oil, or corn oil) is preferably only added later – after the product has already cooled down, and the product is preferably packaged in oxygen-free and light-opaque packages. In case of various breakfast cereals, such as for example those based on corn flour, preferably any other ingredients such as for example honey or sugar are similarly only added after the product has cooled down and are preferably also dehydrated or solidified in a heat-free or low heat process. Preferably the baking is also done in a light-free or reduced light environment – in order to further avoid any processes that might cause various ingredients in the food to degenerate. Another possible variation is to dehydrate these foods in addition or instead also for preferably longer periods at lower temperatures (than the baking temperature) before or after the baking. Another possible variation is to use preferably short microwave exposure before or during or after the baking (for example in a separate microwave oven or in some combined heat-microwave oven, which preferably can activate the microwave radiation also at least partially concurrently with the normal heating) in order to further help the dehydration and/or to aid the baking and/or improve the heat penetration or dissipation.

If the microwave is used also for heating the food, another possible variation is that the Microwave heating is preferably automatically controlled so as also not to exceed the desired limited heat. This controlling is preferably done by at least one of the following options:

- a. At least one temperature sensor in at least one of the inner space of the microwave, the plate upon which the food is placed within the microwave, and/or at least one heat conducting sensor that is inserted into the food. Preferably this is done by a non-metallic good heat conductor, such as for example various plastics or glass or ceramics, and preferably the one or more sensors are inserted into the food from above or from below and can rotate with it (since the food is typically on a rotating plate). Direct sensing of the heat within the food is more preferable since the actual heat depends also for example on the water content of the food, etc. Another possible variation is to use for example some infrared sensor, so that the temperature as sensed as infrared, which has the advantage that the sensing can be done without having to touch the food.
- b. Calculation of the weight of the food (for example by mounting the rotating plate on a digital or analogue scale that is for

example within the bottom part of the Microwave oven) and taking it into consideration.

- c. Automatic control of the duration of the Microwave heating in order not to exceed the desired temperatures.
- d. Automatic control of the Microwave energy in order not to exceed the desired temperatures.
- e. Automatic switching on and off of the Microwave energy in order not to exceed the desired temperatures.

However, another problem with microwave ovens is that they create uneven heating with various cold spots and hot spots, so that the hot spots can typically become for example 30 degrees (Celsius) or more hotter, which means that even if the heat is measured, it does not necessarily show the heat at these hot spots, so for example if some hot spots reach temperatures significantly beyond 120 degrees, then Acrylamides and/or other dangerous elements may be formed there even if the average heat is for example 120 Celsius. This is caused by the fact that the microwave beam itself is irregular and by the fact that the reflections from the internal walls of the microwave oven are irregular. This is typically solved in the prior art by some rotation of the beam itself and by rotating the food on a typically slowly rotating plate. However, this solution is only partial since even with it hot spots and cold spot still exist, probably because the rotation of the beam cannot solve the problem of the reflections and because the rotating plate is not rotated fast enough. A much better solution suggested in the present invention is to change the design of the microwave oven so that instead of a rectangular enclosure it has at least internally the shape of a ball or of a preferably vertical cylinder, for example around the area of the rotating plate, as shown in Figs. 2a-b. Since such a shape has the same reflections from all angles, there is no longer a need for using a rotating plate, and so the oven can be also more silent. In addition, preferably the microwave beam is rotated much faster, so that the spreading of the microwave beam becomes much more even. Since there is no longer a problem of uneven reflections, a fast rotation of the microwave lens is sufficient to create a much better dispersion. Of course, like other features of this invention, these solutions can be used also independently of any other features of this invention. However, uneven dispersion of the heat can also be caused by irregular shape of the food or by different water content in various parts of the food, and this is problem still remains even with the above solution. Another problem is that various studies in the last 10 years have raised concerns that the 2.5 billion oscillations per second caused by the microwave energy is also ripping molecules and cells apart and

creating various dangerous unnatural elements, as can be seen for example at:

<http://www.mercola.com/article/microwave/hazards.htm>

<http://www.nexusmagazine.com/microwave.html>

<http://www.naturalscience.org/en/journal/articles/microwaves.html>

<http://home.planet.nl/~holtj019/GB/Microwave.html>

Therefore the whole practice of using microwave ovens might turn out to be too dangerous. Another possible variation is to use for example ultrasound for heating instead of microwaves and preferably similarly using internal walls that are ball-shaped or in the shape of a preferably vertical cylinder. However, ultrasound also has a problem of being able to rip cells apart, and also the problems of hot spots can be even more severe.

Another possible variation is to use mainly dehydration and/or covering with naturally thickened or solid or semi-solid edible substances, with little or no baking at all. Another possible variation is also to use smaller preferably opaque and oxygen-free inner packages, preferably each the size of a single serving, within the larger package, as described in another patent by the present inventor – Israeli patent application no. 143738 (US application 20030012861). The effectiveness of using low heat is clearly demonstrated in Fig. 1, which shows that up to approx. 120 degrees no Acrylamides are formed. Of course, various combinations of the above and other variations are also possible.

2. Another possible variation is to achieve the crispiness and/or crunchiness for example by covering the potatoes or breakfast cereals or for example the bread (and/or mixing at least a part or parts of them, preferably the external part) with one or more solid or semi-solid edible ingredients that do not need high temperature heating to become solid, such as for example various fibers, molasses, honey that was preferably dehydrated with low heating or with no heating at all, various types of Gelatin, egg or egg white that was heated sufficiently to become hard, slightly cooked and dehydrated wheat flour, and/or for example one or more solid oils that have naturally a convenient melting point, such as for example Cocoa butter, which has a melting point of about 34 degrees etc. Preferably the covering materials are sufficiently thin and/or contain internal cavities or air bubbles, so that their cover can be easily broken, thus maintaining the crunchiness. Covering the product units with these materials or mixing them with just the external crust of the units is more preferable

than mixing them internally, since psychologically the feeling of crunchiness is like crunching bones, so the experience is better if only an external crust is crunchy or breakable and the inside is softer. Of course, various combinations of the above and other variations are also possible.

3. Another possible variation is to add one or more natural antioxidants to the ingredients before and/or during the baking in order to further protect them, such as for example various fruits or fruit extracts or vegetables or vegetable extracts or vitamins, such as for example Vitamin E and/or Vitamin C and/or Curcumin (Tumeric). Of course, various combinations of the above and other variations are also possible.
4. Another possible variation is to mix and/or spray the resulting baked products, preferably after cooling down, for example with meshed parts and/or juice and/or dehydrated powder or parts of similar ingredients that have not been cooked or baked, so that for example if potato chips or French fries have been baked, they are preferably also covered for example by the juice from meshed unbaked potatoes (and/or for example other vegetables or fruits), so that some of the enzymes and other natural ingredients that have been ruined or degraded by the heating are added back into the food. Of course, in order to keep the crispiness, the resulting mix can be for example dried again afterwards, preferably without heat. Of course, various combinations of the above and other variations are also possible.
5. Another possible variation, for example in the case of morning cereals, is to add for example to corn flour or other flours also air producing substances, such as for example yeast and/or baking powder and/or whipped egg white, in order to increase the airiness of the resulting baked typically thin pieces and thus further increase their crispiness. Of course, various combinations of the above and other variations are also possible.
6. Another possible variation is to mechanically add holes to the products to increase their crunchiness, such as for example by making potato chips with various perforations, or making French fries with various perforations or with one or more hollow inner tunnels. Those holes can be added for example before or after the baking. In case of baked products the holes can of course be added for example after the baking has solidified the products, and/or for example air bubbles can be added before or during the baking. However since breads for

example are much softer inside than potatoes, typically air bubbles are added only through yeasts or baking powder, since larger holes are less desirable when the inner part is soft. Another possible variation is to add for example holes by inserting for example hot metal spikes or wires into the food during the baking (for example from below and/or from above and/or from the sides), so that the spikes or wires can preferably have a dual function of creating holes and/or helping heat the food more efficiently so that less time is needed for baking and the heat is more evenly distributed, thus reducing the risk that some parts will be overcooked and some parts undercooked. Preferably such spikes or wires are inserted automatically when the food is closed in position. Preferably this is done in combination with circulating hot air at high speeds in the oven, like for example in turbo-ovens, in order to even further improve the heat dispersion. This can be used also with breads for example since elongated holes in the shape of the spikes or needle are not problematic like large air cavities in bread. In addition, preferably the oven walls are very good heat reflectors so that the heat is reflected back more efficiently to the food. Of course, various combinations of the above and other variations are also possible.

7. Another possible variation for example in bread, or for example in breakfast cereals for example made of corn flour, is to add less water in advance while mixing the flour, or for example add more or less water to various parts of the bread loaf or for example of the individual pieces or units of breakfast cereals or cornflakes, such as for example the circumference or the inner part, for example by creating at least two versions of dough, one with more water and one with less, and for example mixing them or covering one of them with the other, for example using the version that contains less water to envelope the version that contains more water (or vice versa, which means that the inner dough does not remain moist even after baking at lower temperatures, and the outer dough takes more time to solidify, thus allowing better heat convection to the inner part). Of course, in addition or instead, the dough of the outer part can be for example mixed, preferably before using it to envelope the other part, with other edible substances that have a natural tendency to make it more crunchy, such as for example adding various fibers, adding more Gelatin, adding various grains or at least their shelled shells, etc. This way, various types of crunchiness in one or more desired parts of the product (preferably its crust) can be simulated without the need to use scorching heat to create them. Another possible variation is that for example the external envelope is made from whole wheat and the

internal core for example from normal wheat or from light whole wheat, and thus the crust has a natural tendency to be more crunchy than the internal even without scorching it. Another possible variation is, in addition or instead, for example to bake each of the two parts separately for at least part of the process (for example for a few minutes or more) and then preferably use one to envelop the other while they are still moist enough to join properly. This way for example the part that will become the crust, which is preferably thinner, can be dried and baked faster due to its shape and also the inner core which preferably has more mass has better heat convection without the crust. (This can also be done at separate times so that for example the parts that are added to become the crust are prepared in advance or vice versa). Another possible variation is to divide the dough for example even to smaller parts at least for a short time so that they have better heat convection (for example at least for a few minutes), however that can be more problematic since the stitches between the parts can become too weak or form internal undesired crusts. Of course, various combinations of the above and other variations are also possible.

8. Another possible variation is in the other direction – use for example preferably very high heat for a preferably very short time, preferably under conditions of reduced Oxygen, as explained in the reference to Fig. 1. Of course, various combinations of the above and other variations are also possible.
9. Another possible variation is adding for example one or more inhibitors (such as for example inhibiting enzymes) that can act against the tendency of larger molecules (such as for example Asparagine, which is the main suspect) to disintegrate into Acrylamides. Another possible variation is to add to the food (directly and/or for example as a food supplement taken separately by the user) various compounds that can react directly with Asparagine and/or with other relevant ingredients and/or with the Acrylamides and thus combine with them to create more stable molecules that will not further react with other molecules. These compounds can be based for example on the same type of molecules in the body that react with Acrylamides. Of course, various combinations of the above and other variations are also possible.
10. Another possible variation is to remove the Acrylamides for example by a preferably strong electric and/or electromagnetic field, since they

are electrophilic. Of course, various combinations of the above and other variations are also possible.

11. Another possible variation is to separate various ingredients for example before and/or during baking various mixtures (for example breads), for example by centrifuge, so that preferably for example Asparagine is either removed (for example by removing the area where it is concentrated after the application of the centrifuge) or is kept away for example from reducing sugars or carbonyl-containing compounds that, when present, can considerably increase the reaction of Asparagine disintegrating into Acrylamides, and/or for example these other substances are removed. Of course, various combinations of the above and other variations are also possible.
12. Another possible variation is to use for example one or more type of germs and/or bacteria and/or other micro-organisms, such as for example somewhat similar to yeasts but different, so that these germs or bacteria are added for example to dough (and/or to other products that need to be baked or cooked) and can create at least partially processes that are similar to the process of cooking or baking, preferably with little or no heating, and then for example a short time heating for example to 100 or 120 degrees can complete the process (if the germs make only part of the process) and/or give for example the final texture. Preferably these germs are for example various germs that can take apart or change starches or starchy molecules, preferably without creating for example alcohol or other undesired side products during the process. Another possible variation is to use for example other biotechnology techniques to help the baking process. Of course, various combinations of the above and other variations can also be used. Of course these methods can be used also independently of any other features of this invention and similar methods can be used also for other products apart from starchy foods.

As explained above, various combinations or sub-combinations of the above solutions can also be used (within the solutions and/or across them). The above methods are very different from the state-of-the-art for preparing such foods. Similar principles can be applied for example to various snacks, such as for example Osem's Bamba or Elite's Shush, which are typically based on corn flour and peanut butter and are typically covered with vegetable oils. However, solutions 8-11 are less desirable than the others: Solution 8 is problematic, since using high heat for even a very short time can create also other unnatural processes and destroy for example also other ingredients, such as for example fats and/or proteins and/or vitamins and/or

any other important nutrients in these foods), and if any of solutions 1-7 are used (or various combinations of them), there is no need for solutions 9-11. Also, solutions 10-11 for example might cause or require disruption of the cellular structure of the baked food, which might have other adverse health consequences and/or might adversely affect the taste.

Fig. 1 is a graph showing the amount of Acrylamide formation as a function of temperature. This graph is taken from a published research paper by Don Mottram & Bronek Wedzicha, *Suggested mechanism for Suggested mechanism for the formation of acrylamide in foods*, published on http://www.jifsan.umd.edu/Acrylamide/WG1/ WG1_Mottram_D.pdf. First of all, the graph shows clearly that until 120 degrees there are no problems, which confirms that the variations of this invention where lower temperatures are used, can be indeed very safe solutions. On the other hand, as can be seen from the graph, although there is no data on what happens after 190 degrees, the highest levels of Acrylamides (at least under the conditions tested in that research) seem to form around 170 degrees, and the curve starts to fall afterwards. Of course the graph does not necessarily continue to drop down beyond 190 degrees, and might for example become zigzaggy or go up again at higher temperatures – so more research is needed on a much wider spectrum of temperatures and preferably also taking into account the time factor of length of exposure at each temperature level, and preferably also testing different levels of Oxygen. If research will show that at higher temperatures there are points where short exposures create much less Acrylamides, then another possible variation is to bake various foods with a preferably very short exposure at much higher temperatures, such as for example 500 or 800 degrees or more, preferably also under conditions of no Oxygen or reduced Oxygen, and preferably also reduced light. Preferably this research will also be repeated for various types of starchy food in order to find optimal levels for a wide range of foods. Of course this can be also used in combination, so that for example heat until 120 degrees is used for most of the baking process, and very high heat is used for only a very short time, such as for example less than 1 minute. However, as explained above in the reference to solution no. 8, there is no need to use higher heat, since using reduced heat, preferably not substantially exceeding 120 degrees, should be quite sufficient to solve the entire problem, whereas solutions 8-11 can be much more problematic. Also, the reduced levels of Acrylamides shown in the graph after 180 degrees are still quite high and dangerous, so unless the real curves continues to go down considerably at higher temperatures and/or for example under conditions of reduced or no Oxygen and/or for example when the exposure is short enough, solution 8 might not be good enough.

Figs. 2a-b show illustrations of two preferable variations of using ball-shaped or cylinder-shaped internal walls in a microwave oven. As can be seen, instead of a rectangular enclosure, the microwave oven (21) has at least internally the shape of a ball (22b) or of a preferably vertical cylinder (22a), for example around the area of the rotating plate. Since such a shape has the same reflections from all angles, there is no longer a need for using a rotating plate, and so the oven can be also more silent. In addition, preferably the microwave beam is rotated much faster, so that the spreading of the microwave beam becomes much more even. Since there is no longer a problem of uneven reflections, a fast rotation of the microwave lens is sufficient to create a much better dispersion. However, the cylinder shape is more preferable than the ball shape and makes more efficient use of the space. In addition, this can have the further advantage that much less leakage than the standard can be achieved because the cylinder can be for example closed by a rotation of part of it, for example in addition to closing the front door of the oven.

EXAMPLE 1

Potatoes (preferably organically grown – without pesticides or Formaldehyde) are cut into small thin slices (for making potato chips) or cut into small elongated square boxes (for creating French fries), and placed in an oven at preferably 80-120 degrees Celsius or less for example for 15-60 minutes, preferably in an atmosphere of reduced oxygen or reduced air pressure or vacuum or constant air suction or constant flow of air which is preferably dry and oxygen-free or oxygen reduced, so that they can dehydrate faster without the need to resort to higher temperatures, preferably with little or no oxygen, and preferably with little or no light within the oven. Then they are cooled down and then soaked in preferably non-heated non-refined oil, such as for example olive oil, Flax oil, or hempseed oil, and preferably packaged in light-opaque, oxygen-free packaging. Another possible variation is that the oils themselves or some of them are made harder without the usual destructive processes of creating solidified oils, for example by mixing them with harder edible substances, for example as described in PCT application no. WO0150873 by Meir Eini for creating thickened oil compositions of edible oil without destroying the oil, preferably with the improvements suggested by the present inventor in Israeli patent application 143738 (US application 20030012861).

EXAMPLE 2

Breakfast cereals, based on ingredient such as for example corn flour and/or other grains, are preferably divided into two parts: 1. Ingredients, such as for

example various grains, which are kept as natural as possible, preferably with no heating at all, or at most with cold dehydration. 2. Ingredients, such as for example corn flour, which are placed in an oven at preferably low temperatures, such as for example at any of the degrees between 80-100 Celsius or less, preferably for 15-60 minutes, preferably in an atmosphere of reduced oxygen or reduced air pressure or vacuum or constant air suction or constant flow of air, which is preferably dry and oxygen-free or oxygen reduced, so that they can dehydrate faster without the need to resort to higher temperatures, preferably with little or no oxygen, and preferably with little or no light within the oven. They are cooled down and then soaked or covered in preferably non-heated or little-heated naturally solid or semi-solid substances, such as for example various fibers, molasses, honey or dried or dehydrated honey, various types of Gelatin, slightly cooked and dehydrated wheat flour, and/or for example one or more solid oil that has naturally a convenient melting point, such as for example Cocoa butter, which has a melting point of about 34 degrees etc.

EXAMPLE 3

Same as example 1 or 2, except that various natural antioxidants, such as for example vitamin C and/or E are added to the ingredients in significant quantities before they are heated at all.

EXAMPLE 4

Same as example 1 or 2 or 3, except that preferably after cooling down the resulting baked products are mixed or sprayed or soaked for example with meshed parts and/or juice of similar ingredients that have not been cooked or baked, so that for example if potato chips or French fries have been baked, they are preferably also covered for example by the juice from meshed uncooked potatoes (and/or for example other vegetables or fruits), so that some of the enzymes and other natural ingredients that have been ruined or degraded by the heating are added back into the food.

As explained above, in all of the above examples preferably the resulting products are then packed in Oxygen free and opaque-to-light packages, preferably each in the size of a single serving preferably within a larger package or box, so that for example opening the morning cereals box does not enter oxygen to the rest of the packages except for the package that is opened for that meal.

While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications, expansions and other applications of the invention may be made which are included within the scope of the present invention, as would be obvious to those skilled in the art.

CLAIMS

I claim:

1. A method of preparing healthy baked starchy foods without significant formation of Acrylamides, wherein at least one of the following steps is used:
 - a. The Processing is done at least partially under conditions of at least one of reduced oxygen, oxygen-free, reduced light, light-free.
 - b. The baking is done at temperatures below the temperatures where Acrylamides start to form.
2. The method of claim 1 wherein said foods are baked at low temperatures and are also dehydrated by at least one of a vacuum, reduced air pressure, reduced oxygen, constant air suction, and constant flow of dry air, at least one of before, during and after the baking, in order to allow them to dehydrate more quickly without the need to reach higher temperatures.
3. The method of claim 2 wherein at least one of:
 - a. Said foods are at least one of chips, French fries, and other foods that are commonly prepared with oils, and oil is added only later – after the product has already cooled down.
 - b. Said foods are breakfast cereals and at least one of honey, sugar, and other covering ingredients are only added after the product has cooled down.
 - c. Said foods are breakfast cereals and at least one of honey, sugar, and other covering ingredients are only added after the product has cooled down, and said covering ingredients are added after they have also been at least one of dehydrated and solidified in at least one of a heat-free and low heat process.
4. The method of any of the above claims wherein crispiness and/or crunchiness is achieved by covering the food units and/or mixing at least one part of them with at least one of solid and semi-solid edible ingredients that do not need high temperature heating to become solid.
5. The method of claim 4 wherein said covering ingredients are at least one of fibers, molasses, honey, dehydrated honey, at least one type of Gelatin, slightly cooked and dehydrated wheat flour, and at least one solid oil that has naturally a convenient melting point.

6. The method of any of the above claims wherein at least one natural antioxidant is added to the ingredients before and/or during the baking in order to further protect them.
7. The method of claim 6 wherein said antioxidants are at least one of fruits, fruits extracts, vegetables, vegetable extracts, and vitamins.
8. The method of any of the above claims wherein the resulting baked products are later at least one of mixed, covered, injected, and soaked with similar ingredients that have not been cooked or baked, so that some of the enzymes and other natural ingredients that have been degraded by the heating are added back into the food.
9. The method of any of the above claims wherein the temperatures in the oven do not reach at least one of:
 - a. Beyond 120 degrees.
 - b. Beyond 100 degrees.
 - c. Beyond 80 degrees.
10. A composition of starchy foods comprising at least one starchy food baked at most at temperatures below the temperatures where Acrylamides start to form and is made crispy and/or crunchy by at least one of Low temperature dehydration, and Covering and/or mixing with at least one of a solid and semi-solid natural edible substances.
11. The composition of claim 10 wherein said foods are at least one of chips, French fries, and other foods that are commonly prepared with oils, and the oil was added only later – after the product has already cooled down, so that the product is covered with unheated oil.
12. The composition of claim 11 wherein at least one of the following:
 - a. Said oil is unrefined unheated oil.
 - b. Said oil has been solidified by mixing it with naturally solid edible substances.
 - c. Said oil is at least one of hempseed oil, Flax oil, Corn oil, Sunflower oil, and olive oil.
 - d. Said oil is at least one of Cocoa butter and other oils with a naturally low solidification temperature.
13. The composition of claim 10 wherein said foods are breakfast cereals and they are covered by at least one of honey, sugar and other

covering ingredients that were added after the product has cooled down.

14. The composition of any of the above claims wherein crispiness is achieved by covering the food pieces and/or mixing at least one part of them with at least one of solid and semi-solid edible ingredients that do not need high temperature heating to become solid.
15. The composition of claim 14 wherein said covering ingredients are at least one of various fibers, molasses, honey, dehydrated honey, various types of Gelatin, slightly cooked and dehydrated wheat flour, and solid oils that have naturally a convenient melting point.
16. The composition of any of the above claims wherein various natural antioxidants were added to the ingredients before and/or during the baking in order to further protect them.
17. The composition of claim 16 wherein said antioxidants are at least one of fruits, fruits extracts, and vitamins.
18. The composition of any of the above claims wherein after cooling down the resulting baked products were at least one of mixed, covered, injected, and soaked with similar ingredients that have not been cooked or baked, so that some of the enzymes and other natural ingredients that have been degraded by the heating were added back into the food.
19. The method of any of the above claims wherein the foods are dehydrated at temperatures lower than the baking temperature at least one of before the baking and after the baking.
20. The method of any of the above claims wherein at least one of yeast, baking powder, whipped egg white, and other air producing substances are added in order to increase the airiness of baked thin pieces and thus further increase their crispiness.
21. The composition of any of the above claims wherein at least one of yeast, baking powder, whipped egg white, and other air producing substances are added in order to increase the airiness of baked thin pieces and thus further increase their crispiness.

22. The method of any of the above claims wherein short microwave exposure is also used to facilitate the dehydration and/or aid the baking and/or improve the heat penetration.
23. The method of any of the above claims wherein the resulting products are packaged in light-free and oxygen free packages.
24. The method of any of the above claims wherein the packaging is based on inner smaller light-opaque and oxygen free packages within a larger and stronger package, so that only a small part of the product is exposed to light and oxygen at any time.
25. The method of claim 24 wherein each inner package is the size of one serving.
26. The method of any of the above claims wherein holes are added to the products to increase their crunchiness and at least one of the following exists:
 - a. Said products are at least one of chips and French Fries and said holes are at least one of various perforations and at least one hollow tunnel.
 - b. Said products are baked mixtures and holes are added by adding air bubbles.
27. The method of any of the above claims wherein at least one of the following features exists:
 - a. The products contain flour, and less water is added in advance while mixing the flour, so that the product can become dry enough even when baked at low temperatures.
 - b. The products contain flour, and different amounts of water are added to various parts of the pieces.
 - c. The circumference and the inner core of each unit of the product contain in advance different amounts of water in order to simulate various types of crunchiness.
28. The composition of any of the above claims wherein holes have been mechanically added to the products to increase their crunchiness.
29. The composition of claim 28 wherein said products are at least one of chips and French Fries and said holes are at least one of various perforations and at least one hollow tunnel.

- 30.A method of preparing healthy baked starchy foods without significant formation of Acrylamides, wherein the processing is done under conditions of very high heat for a very short time.
- 31.The method of claim 30 wherein said baking is done under conditions of reduced Oxygen or no Oxygen.
- 32.The method of any of the above claims wherein at least one inhibitor is added that can act against the tendency of larger molecules to disintegrate into Acrylamides.
- 33.The method of any of the above claims wherein at least one compound that can react directly with Asparagine and/or with other relevant ingredients and/or with the Acrylamides is added so that it can combine with them to create more stable molecules that will not further react with other molecules.
- 34.The method of claim 33 wherein at least one of the following exists:
- Said compounds are at least one of: Added directly to the baked food, and Taken as a supplement by the user.
 - Said compounds are based on the same type of molecules in the body that react with Acrylamides.
- 35.The method of any of the above claims wherein the Acrylamides are removed by an electric and/or electromagnetic field.
- 36.The method of any of the above claims wherein various ingredients are separated so that they are removed or are kept away from other ingredients that could react with them to increase Acrylamide formation, at least one of before and during the baking.
- 37.The method of claim 36 wherein at least one of:
- Said ingredients are at least one of Asparagine, reducing sugars, and carbonyl-containing compounds.
 - Said separation is done by centrifuge.
- 38.The method of any of the above claims wherein hot metal spikes and/or wires are inserted into the food during the baking, so that the spikes and/or wires can at least one of create holes and help heat the food more efficiently so that less time is needed for baking.

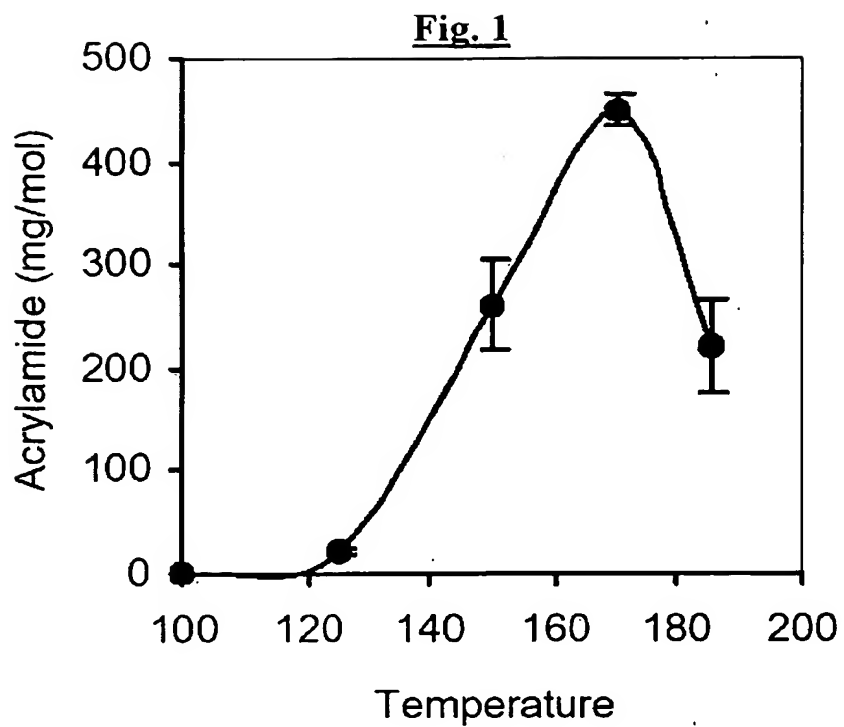
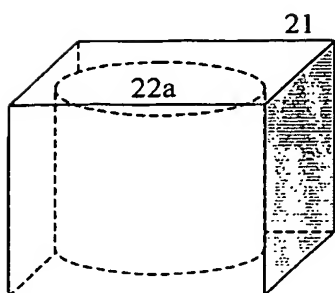
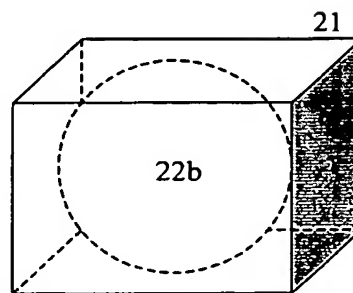
39. The method of claim 22 wherein the Microwave heating is controlled so as not to exceed the desired low heat, and said controlling is done by at least one of:
- At least one temperature sensor in at least one of: The inner space of the microwave, The plate upon which the food is placed within the microwave, and At least one heat conducting sensor that is inserted into the food.
 - Calculation of the weight of the food and taking it into consideration.
 - Automatic control of the duration of the Microwave heating in order not to exceed the desired temperatures.
 - Automatic control of the Microwave energy in order not to exceed the desired temperatures.
 - Automatic switching on and off of the Microwave energy in order not to exceed the desired temperatures.
40. The method of any of the above claims wherein a microwave oven is used for at least part of the baking and instead of a rectangular enclosure said microwave has at least internally the shape of at least one of a ball and a substantially vertical cylinder, so that the reflections from the internal walls become more even, and there is no rotating plate that rotates the food.
41. The method of claim 40 wherein the microwave beam is rotated considerably faster than usual, so that the spreading of the microwave beam becomes much more even.
42. The method of any of the above claims wherein at least two versions of dough are used, and wherein one of the versions is used to cover or envelope the other, and at least one of:
- The dough of the outer part has been mixed with at least one of more Gelatin, grains, shells of grains, and other edible substances that have a natural tendency to make it more crunchy.
 - The external envelope is made from whole wheat and the internal core from less whole wheat and thus the crust has a natural tendency to be more crunchy than the internal part.
 - The external envelope and the inner core contain in advance different amounts of water in order to simulate various types of crunchiness.
 - Each of the two parts is baked separately for at least part of the process, so that the part that will become the crust, which is thinner, can be dried and baked faster due to its shape.

43. The composition of any of the above claims wherein at least two versions of dough are used, and wherein one of the versions is used to cover or envelope the other, and at least one of:

- a. The dough of the outer part has been mixed with at least one of more Gelatin, grains, shells of grains, and other edible substances that have a natural tendency to make it more crunchy.
- b. The external envelope is made from whole wheat and the internal core from less whole wheat, and thus the crust has a natural tendency to be more crunchy than the internal part.
- c. The external envelope and the inner core contain in advance different amounts of water in order to simulate various types of crunchiness.

44. The method of any of the above claims wherein germs and/or bacteria and/or other micro-organisms are added to dough and/or to other products that need to be baked or cooked and can at least one of break down starchy molecules, change starchy molecules, and create at least partially processes that are similar to the process of cooking or baking with little or no heating, and then a short time heating can complete the process.

1/1

**Fig. 2a****Fig. 2b**

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
15 January 2004 (15.01.2004)

PCT

(10) International Publication Number
WO 2004/004484 A3

(51) International Patent Classification⁷: **A21D 6/00**

(21) International Application Number:
PCT/IL2003/000551

(22) International Filing Date: 2 July 2003 (02.07.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
150534 2 July 2002 (02.07.2002) IL
60/395,094 5 July 2002 (05.07.2002) US
60/444,972 2 February 2003 (02.02.2003) US
60/450,531 17 February 2003 (17.02.2003) US

(71) Applicant and

(72) Inventor: Mayer, Yaron [IL/IL]; 21 Ahad Haam Street,
92151 Jerusalem (IL).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,

LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NI, NO, NZ, PG, PH, PL, PT, RO, RU, SC, SD,
SE, SG, SK, SL, SY, TJ, TM, TR, TT, TZ, UA, UG, US,
UZ, VC, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments

(88) Date of publication of the international search report:
22 April 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: COMPOSITION AND METHOD FOR PREPARING CRISPY STARCHY FOODS

(57) Abstract: The consumption of highly heated starchy foods, such as for example potato chips, French fries, or breakfast cereals, has become very popular in the last 30 years, since for some reason consumers have been led into liking crispy or crunchy foods. However, recent finding published world-wide on April and June 2002 indicated that heating foods that are rich in carbohydrates to high temperatures, such as for example potato chips, French fries and various types of morning cereals, can cause the formation of large amounts of Acrylamides - up to hundreds or thousands of times more than what the World Health Organization (WHO) allows in drinking water. These substances are unnatural and there is evidence that they are dangerous carcinogens and also that they can cause damage to the human nervous system. The present invention tries to solve the above problems by preferably achieving crispiness or crunchiness and preferably also other customary properties in these foods, without heating them to high temperatures - preferably not substantially above 100 or 120 degrees Celsius.

WO 2004/004484 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL03/00551

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : A21D 6/00
US CL : 426/496

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 426/496,443,446,467,618,620,621,637,808

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,001,409 A (GIMMLER et al) 14 December 1999, columns 16-17.	1-5,7,10-15,17,25,29,30-32,34,37,39,41

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "B" earlier application or patent published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

04 February 2004 (04.02.2004)

Date of mailing of the international search report

01 MAR 2004

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Facsimile No. (703)305-3230

Authorized officer

Lien Tran

Telephone No. 703-308-0661

DEBORAH THOMAS
PARALEGAL SPECIALIST

dot

INTERNATIONAL SEARCH REPORT

International application No. PCT/IL03/00551

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claim Nos.: 6,8,9,16,18-24,26-28,33,35-38,40 and 42-44
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐
☐

- The additional search fees were accompanied by the applicant's protest.
No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

PCT/IL03/00551

Continuation of Item 4 of the first sheet:

The title is too long.

The new title is " Composition And Method For Preparing Crispy Starchy Foods"